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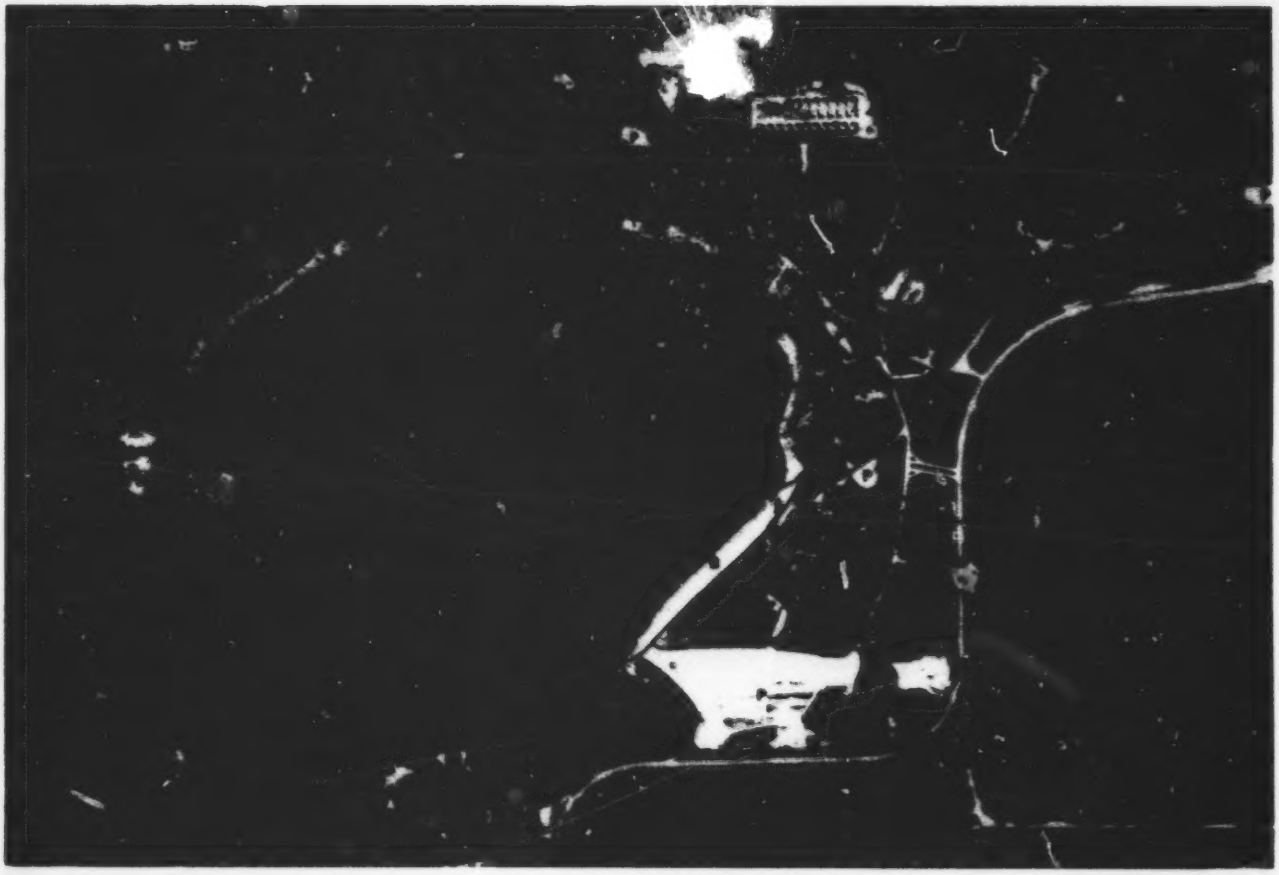
Soil survey of

Wabamun Lake Provincial Park study area

and interpretation for recreational use

G.M. Greenlee



ALBERTA RESEARCH COUNCIL

Natural Resources Division
Soils Department

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Alberta Institute of Pedology
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Preface

This report is one of a series describing detailed and semi-detailed soil surveys, which were conducted in the following Alberta Provincial Parks during the summer of 1976: Cypress Hills, Writing-on-Stone, Dry Island Buffalo Jump, Jarvis Bay, Wabamun Lake, Thunder Lake, Moose Lake and Moonshine Lake. Also included were the Blue Lake Centre in William A. Switzer Provincial Park; as well as areas near Carseland and Hilliard's Bay (on the northwestern shore of Lesser Slave Lake). The total area mapped was approximately 30 000 ha.

A general guidebook has been prepared to accompany soil survey reports written for Alberta Provincial Parks and recreation areas (Greenlee, 1981). It includes general discussions of the following: soil formation; the Canadian soil classification system; soil characteristics and other factors that affect the use of soils for recreational and related purposes; Luvisolic, Organic and Solonetzic soils; soil erosion; methodology; soil and landform maps that accompany the soil survey reports; an explanation of soil interpretations and guidelines for developing them; chemical and physical properties of soils; and the landform classification system used by Canadian soil pedologists. Also included is a glossary. Specific results and interpretations for the areas covered by this study are presented in the ensuing report.

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Summary

The mapped area, comprising about 270 ha, is located about 55 km west of Edmonton adjacent to highway 16 on the south side. Most of the study area is covered by moderately fine-textured till, and two small patches of medium- to moderately fine-textured lacustrine sediments border the eastern lakeshore. A few sporadic organic soil deposits are also found. This region has a cold snow-forest climate with humid winters, characterized by frozen ground and a snow cover of several months duration. Summers are cool and short with less than four months where the average temperature is above 10 °C, and the average temperature of the coldest month below −3 °C. The study area is situated in the aspen grove section of the boreal forest region, where only trembling aspen is abundant in the natural stands.

Five map units were recognized in the study area. The key profile types are Orthic Gray Luvisols, Orthic Humic Gleysols, Humic Luvic Gleysols peaty phase, and Humisols. These are distributed over the landscape in relation to landform, parent material and drainage. Each map unit is a soil series, and the distribution is shown on the soil map.

Soil interpretations of each map unit are made for fully serviced campgrounds, picnic areas, lawns and landscaping, paths, trails, buildings, septic tank absorption fields, trench-type sanitary landfills, road location, source of roadfill and source of sand or gravel.

Map Unit 1 soils cover most of the study area and are well suited for recreational development when found on suitable topography. Soils of the other map units have moderate to severe limitations. Map Unit 1 soils have severe limitations for road construction, and soils of the other map units have severe to very severe limitations. A source of sand or gravel was not found in the study area. Careful study of the soil map and tables 4 to 15 inclusive (soil limitation and suitability tables) will reveal areas suitable for particular uses.

A soil survey properly interpeted can be a very useful tool when making a proper design for a recreational area. All soil differences that occur in the field cannot, however, be shown on the soil map. Thus, for design and construction of specific recreational facilities, an on-site investigation is usually required.

Introduction

Size and location

The mapped area, comprising about 270 ha, is located about 55 km west of Edmonton adjacent to highway 16 on the south side (figure 1). Also it is adjacent to the northeastern shore of Wabamun Lake, and encompasses the southwest quarter and north half of section 7, township 53, range 3; and the north half of section 12, township 53, range 4; west of the fifth meridian.

Physiography and surficial deposits

The study area is in the Eastern Alberta Plains division of the Interior Plains physiographic region (Government and University of Alberta, 1969). The bedrock has been classified as the Upper Cretaceous Whitemud and Battle Formations, which are nonmarine in origin (Green, 1972). Elevations increase gradually from south to north in the study area. The highest of about 760 m occurs near the northeastern corner and the lowest of about 730 m is adjacent to the lakeshore, a difference of about 30 m. Drainage of the area is into Wabamun Lake, which in turn is drained through Wabamun Creek into the North Saskatchewan River to the southeast.

Most of the study area is covered by moderately fine-textured till. The only exceptions are a small patch of medium- to moderately fine-textured lacustrine sediments bordering the eastern lakeshore, and a small patch of moderately fine-textured lacustrine sediments in the

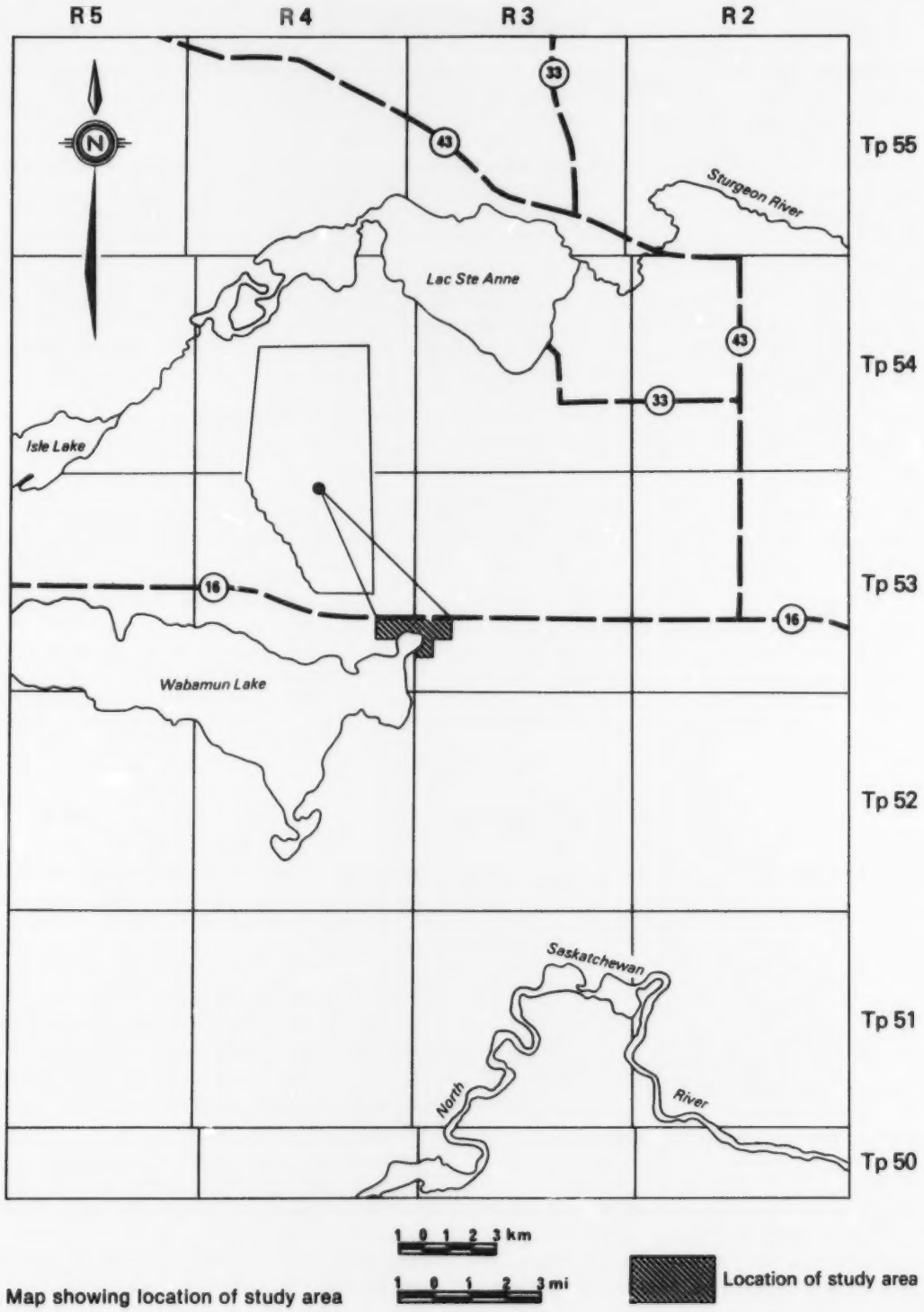


Figure 1. Map showing location of study area

southwestern corner of the study area. A few sporadic organic soil deposits are also found in depressional locations.

Climate

The climate of the mapped area is designated humid microthermal in Koeppen's climatic classification (Trewartha and Horn, 1980). This is described as a cold snow-forest climate with humid winters, characterized by frozen ground and a snow cover of several months duration. Summers are cool and short, having less than four months with an average temperature above 10 °C. The average temperature of the coldest month is below – 3 °C.

Weather records for 1951 through 1980 from the Namao Airport about 60 km east and 10 km north of the study area, and at an elevation of 688 m were used to compile the following information (Environment Canada, 1982a and b): the mean annual temperature is 2.4 °C. July is the warmest month of the year with a mean temperature of 16.9 °C, and January is the coldest month with a mean temperature of – 15.6 °C. The mean annual precipitation is 451 mm and 71 percent falls as rain. The average frost-free period is 129 days. Somewhat lower average temperatures can be expected in the study area, however, because elevations are significantly higher than at Namao Airport. The agroclimatic map of Alberta (Bowser, 1967) indicates a frost-free period of only 75 to 90 days.

Vegetation

The mapped area is situated in the aspen grove section of the boreal forest region as classified by Rowe (1972). In the aspen grove section, only trembling aspen is abundant in the natural stands. Balsam poplar is frequently present on moist lowlands, and occasionally prominent on uplands after fire. White birch has a sporadic distribution, but is usually found only on rough broken land. Prairie and meadow patches were interspersed with the aspen bluffs in the original vegetation.

Aspen is the predominant vegetation throughout the study area. Scattered variable proportions of balsam poplar, white spruce and white birch are also found. Since the Outdoor Recreation Planning Branch of Alberta Recreation and Parks conducts biological studies of provincial parks and recreation areas, the vegetation is not extensively discussed in this report. Some common plants observed growing on different soils are indicated as part of the map unit descriptions. These are listed as follows (Moss, 1959; Cormack, 1967): aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), white spruce (*Picea glauca*), black spruce (*Picea mariana*), white birch (*Betula papyrifera*), willow (*Salix* spp), beaked hazelnut (*Corylus cornuta*), dogwood (*Cornus stolonifera*), Canadian buffalo-berry (*Shepherdia canadensis*), saskatoon-berry (*Amelanchier alnifolia*), low-bush cranberry (*Viburnum edule*), alder (*Alnus* spp), swamp birch (*Betula pumila* var. *glandulifera*), wild rose (*Rosa* spp), alsike clover (*Trifolium hybridum*), horsetail (*Equisetum* spp), marsh marigold (*Caltha palustris*), Labrador tea (*Ledum groenlandicum*), sedge (*Carex* spp), other forbs, grass (various species) and feathermoss.

Soils

Five map units were recognized in the study area. The soils of two were classified in the Gleysolic order, and one in each of the Luvisolic, Organic and Regosolic Orders in the Canadian soil classification system (Canada Soil Survey Committee, 1978). The system is outlined in Greenlee (1981). Pertinent features of the map units are outlined in table 1.

Soils of the Luvisolic Order are well to imperfectly drained mineral soils characterized by an Ae horizon near the surface, which is usually from 7.5 to 30 cm thick. It is a leached gray-colored horizon, very low in organic matter (humus) content and in plant nutrients. Luvisolic soils in their natural state commonly have surface L-H and Ah horizons as well. The L-H horizon ranges from 2.5

Table 1. Key to the soils

Map Unit	Classification	Parent material	Surface texture	Slope (class and gradient)	Surface stoniness	Drainage	Comments and limitations
1	Orthic Gray Luvisol	moderately fine-textured till	fine sandy loam to sandy loam	d,e,f (>5 to to 30%)	1	well drained	Slight to severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel — excessive slope, erosion hazard, lack of Ah horizon, high clay content, moderate to high shrink-swell potential, susceptibility to frost heave, slow permeability.
2	Orthic Humic Gleysol	medium to moderately fine-textured lacustrine	loam	a (0 to 0.5%)	0	poor	1. No lime horizon within 120 cm of surface. 2. Water table 115 cm below surface. Severe to very severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel—seasonally high groundwater table or surface ponding, flooding hazard (overflow), groundwater contamination hazard, susceptibility to frost heave.
3	Orthic Regosol overlying Rego Gleysol, peaty phase	moderately fine-textured till, overlying moderately fine-textured lacustrine	clay loam	B (>0.5 to 2%)	0	well drained	The Orthic Regosol appears to be a man-made soil, overlying the original Rego Gleysol, peaty phase. Slight to very severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel—seasonally high groundwater table, high clay content, slow permeability, slippery or sticky when wet, lack of Ah horizon, high lime content (soil nutrient imbalance), moderate to high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard.
4	Humic Luvic Gleysol, peaty phase	moderately fine-textured lacustrine	loam	a (0 to 0.5%)	0	poor	Severe to very severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel—seasonally high groundwater table or surface ponding, organic surface layer more than 15 cm thick, flooding hazard (overflow), groundwater contamination hazard, moderate to high shrink-swell potential, susceptibility to frost heave.
H	Humisol	humic peat	humic peat	a (0 to 0.5%)	0	very poor	Water at or very near the soil surface. Very severe limitations, very poor source of roadfill, unsuitable as a source of sand or gravel—Organic soil, seasonally high groundwater table, flooding hazard (overflow), lack of Ah horizon, groundwater contamination hazard, high shrink-swell potential.

to 12.5 cm or more in thickness; however, the Ah horizon below is usually less than 5 cm thick, and often absent altogether. When Luvisolic soils are cultivated, the L-H and Ah horizons quickly become mixed with the Ae, resulting in gray-colored fields. Also, the L-H and Ah horizons rapidly break down under heavy foot traffic in recreation areas, and often disappear completely from a combination of physical destruction and soil erosion. When thoroughly dried out, the Ae horizon is often baked and hard, so that plant seedlings may be unable to push up through the crust. Entry of moisture from rainfall may be hampered and runoff increased, thereby enhancing soil erosion. This problem is especially serious on steep slopes.

Well-drained Luvisolic soils developed on moderately fine-textured till cover most of the study area.

Soils of the Organic order include all soils that have developed largely from organic deposits, contain more than 30 percent organic matter by weight, and meet specifications of depth and horizon thickness within a defined control section. Most Organic soils are either water-saturated or nearly so for much of the year unless artificially drained. The organic deposits are derived primarily from the decomposition of hydrophytic or mesohydrophytic vegetation. The further classification and naming of the great groups into Fibrisols, Mesisols and Humisols depends on the occurrence and identification of three major diagnostic layers: Fibric, Mesic and Humic. Fibric layers are the least decomposed of all the organic soil materials and have large amounts of well-preserved fibers, which are readily identifiable as to botanic origin. The organic matter of humic layers is in a highly decomposed state, and often has a smooth greasy feel when moist. It has the least amount of recognizable plant fiber, and is usually darker in color than fibric or mesic materials. It is relatively stable and changes little in physical or chemical composition with time. The organic matter of mesic layers is in an intermediate stage of decomposition between that of fibric and humic layers, and is partially altered both chemically and physically. Management problems in areas of cultivated Organic soils involve the maintenance of controlled drainage, adequate fertilization and tillage practices necessary to maintain a firm bed for seed germination and root development. Overdrainage and dessication of peat are detrimental to crop production and to the maintenance of the organic layers in a desirable physical condition. Under cultivation, many Organic soils show deficiencies in macro and micro mineral nutrients, and most require the application of phosphorus and potassium to obtain maximum productivity. Special problems also exist in using Organic soils for construction purposes. These are their low bearing strength, high shrink-swell potential and susceptibility to frost heaving.

Sporadic patches of Organic soils occur in depressional locations throughout much of the mapped area.

Soils of the Gleysolic order are poorly drained mineral soils whose profiles reflect the influence of waterlogging for significant periods. Water saturation causes reducing conditions due to a lack of aeration. These conditions result in gleyed horizons having dull gray to olive, greenish or bluish-gray moist colors, frequently accompanied by prominent usually rust-colored mottles resulting from localized oxidation and reduction of hydrated iron oxides.

Only two small patches of Gleysolic soils developed on medium- to moderately fine-textured lacustrine are found in the study area. Both are adjacent to the lakeshore on the east side.

Soils of the Regosolic Order are rapidly to imperfectly drained mineral soils with profile development too weakly expressed to meet the requirements for classification in any other order. They lack any expression of a B horizon and, therefore, reflect essentially the characteristics of the C horizons and parent materials from which they are formed.

Only one patch of Regosolic soils was mapped near the southwestern corner of the study area. This is a man-made soil where fill material (till) from another location has been hauled in and spread over the original soil. Soil profile development has not begun, as insufficient time has elapsed.

Very minor differences exist among some map units. However, the differences are usually significant with regard to a particular recreational or engineering use, and thus justify separation of different map units. They are described in chronological order, and horizon thicknesses represent averages. Thicknesses of comparative horizons in identical soil profiles often vary as much as 10 to 40 percent from the norm at different points in the landscape.

The dominant plant species are listed using common names. These are very general lists, and not intended to be complete.

Map Unit 1

Classification: Orthic Gray Luvisol
Parent material: moderately fine-textured till
Landform: hummocky morainal (Mh)
Slope: gently to strongly rolling (>5 to 30%)
Surface stoniness: slightly stony (1)
Drainage: well drained
Vegetation: mixed forest—predominantly aspen; scattered variable proportions of balsam poplar, white spruce, white birch; understory is variable combinations of wild rose, willow, beaked hazelnut, dogwood, saskatoon-berry, low-bush cranberry, Canadian buffalo-berry, forbs, grass.
Profile description: Orthic Gray Luvisol

Horizon	Thickness (cm)	Field texture	Structure	Consistence
L-H	5-8	leaf litter		
Ae	10-15	fine sandy loam to sandy loam	platy	slightly hard, dry
Bt	50	clay loam	blocky	firm, moist
BC	60	clay loam	amorphous	very firm, moist
Cca	at 120	clay loam	amorphous	very firm, moist

Limitations: Slight to severe— severe for septic tank absorption fields and road location; moderate on suitable topography for lawns and landscaping, buildings with basements, trench-type sanitary landfills; slight on suitable topography for all other uses; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include excessive slopes, erosion hazard, lack of an Ah horizon, high clay content, moderate to high shrink-swell potential, susceptibility to frost heave, slow permeability.

Map Unit 2

Classification: Orthic Humic Gleysol
Parent material: medium- to moderately fine-textured lacustrine
Landform: level lacustrine (Ll)
Slope: nearly level (0 to 0.5%)
Surface stoniness: nonstony (0)
Drainage: poor
Vegetation: grass, sedge, forbs; scattered balsam poplar and willow
Profile description: Orthic Humic Gleysol

Horizon	Thickness (cm)	Field texture	Structure	Consistence
Ah	20-25	loam	granular	very friable, moist
Bg	75-80	loam to sandy clay loam	amorphous	very friable to friable, moist

Comments:
1. A lime horizon was not found within 120 cm of the surface.
2. A water table was found 115 cm below the surface.

Limitations: Severe to very severe— very severe for septic tank absorption fields and trench-type sanitary landfills; severe for all other uses; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures and seasonally high groundwater table or surface ponding. Other limitations include flooding hazard (overflow), groundwater contamination hazard, susceptibility to frost heave.

Map Unit 3

Classification: Orthic Regosol overlying Rego Gleysol, peaty phase
Parent material: moderately fine-textured till, overlying moderately fine-textured lacustrine
Landform: anthropogenic veneer, overlying level lacustrine (Av/Ll)
Slope: very gently sloping (>0.5 to 2%)
Surface stoniness: nonstony (0)
Drainage: well drained
Vegetation: seeded lawn-grass, alsike clover
Profile description: Orthic Regosol, overlying Rego Gleysol, peaty phase

Horizon	Thickness (cm)	Field texture	Structure	Consistence
Cca	75	clay loam	amorphous	friable, moist
IIOh	25	humic peat		
IICcag	at 100	clay loam	amorphous	firm, moist

Comments: The Orthic Regosol appears to be a man-made soil, whereby fill material (till) from another location has been hauled in and spread over the original soil, the Rego Gleysol peaty phase.

Limitations: Slight to very severe— slight for buildings without basements; severe for buildings with basements and road location; very severe for septic tank absorption fields and trench-type sanitary landfills; moderate for all other uses; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures and seasonally high groundwater table. Other limitations include high clay content, slow permeability, slippery or sticky when wet, lack of an Ah horizon, high lime content (soil nutrient imbalance), moderate to high shrink-swell potential, susceptibility to frost heave, groundwater contamination hazard.

Map Unit 4

Classification: Humic Luvic Gleysol, peaty phase
Parent material: moderately fine-textured lacustrine
Landform: level lacustrine (Ll).
Slope: nearly level (0 to 0.5%)
Surface stoniness: nonstony (0)
Drainage: poor
Vegetation: aspen, balsam poplar, white birch, dogwood, willow, wild rose, horsetail, other forbs, grass
Profile description: Humic Luvic Gleysol, peaty phase

Horizon	Thickness (cm)	Field texture	Structure	Consistence
Oh	20	humic peat		
Ah	7-10	loam	granular	very friable, moist
Aeg	25	loam	platy	friable, moist
Btg	40	clay loam	amorphous	firm, moist
Ccag	at 75	clay loam	amorphous	firm, moist

Limitations: Severe to very severe— very severe for septic tank absorption fields and trench-type sanitary landfills; severe for all other uses; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures and seasonally high groundwater table or surface ponding. Other limitations include organic surface layer more than 15 cm thick, flooding hazard (overflow), groundwater contamination hazard, moderate to high shrink-swell potential, susceptibility to frost heave.

H (Organic soil)

Classification: Humisol
Parent material: humic peat
Landform: horizontal fen (Nh)
Slope: nearly level (0 to 0.5%)
Surface stoniness: nonstony (0)
Drainage: very poor
Vegetation: black spruce, white birch, willow, alder, swamp birch, dogwood, horsetail, Labrador tea, marsh marigold, sedge, feathermoss
Profile description: Humisol

Horizon	Thickness (cm)	Field description
Oh	130+	predominantly humic peat

Comments: These Organic soil areas are very wet. The water table commonly occurs at or very near the soil surface.

Limitations: Very severe for all uses; very poor source of roadfill; unsuitable as a source of sand or gravel due to Organic soil, unsuitable textures, seasonally high groundwater table. Other limitations include flooding hazard (overflow), lack of an Ah horizon, groundwater contamination hazard, high shrink-swell potential.

Special features

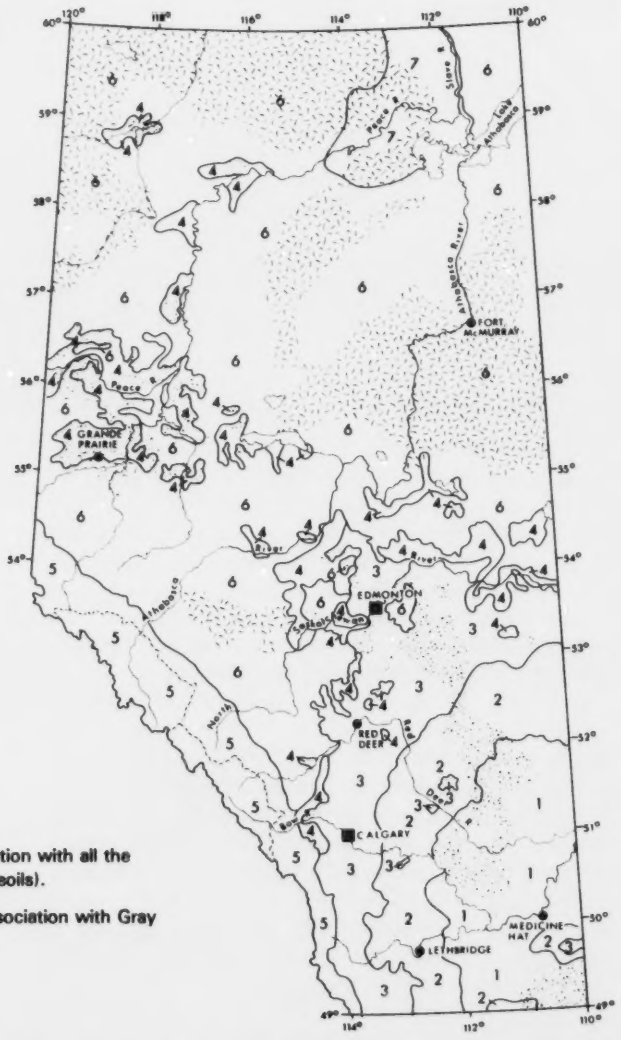
The soils in Alberta have been classified into broad general zones (figure 2) as established by Alberta Soil Survey during the normal course of soil surveys, and correlated with temperature and precipitation records. Annual precipitation amounts change gradually from one soil zone to another, and are not abrupt changes at the point where a zone boundary has been located. Thus, a zone boundary is a broad transitional belt, which can be many kilometres across. Topsoil colors reflect this gradual change. For example, in the center of the Brown Soil Zone (annual precipitation about 30 to 33 cm), topsoil colors are brown. Similarly in the center of the Dark Brown Soil Zone (annual precipitation about 38 cm), topsoil colors are dark brown. Between these two zones, topsoil colors are brown to dark brown, and annual precipitation is about 35 cm. The boundary between the two soil zones has been placed approximately at that midpoint.

Zonal soils are soils with well-developed soil characteristics that reflect the zonal or normal influences of climate and living organisms, mainly vegetation, as active factors of soil genesis. Examples are Brown, Dark Brown, or Black soils of the Brown, Dark Brown or Black Soil Zones respectively. Intrazonal soils are soils with morphology that reflects the influence of some local factor of relief, parent material or age, rather than of climate and vegetation. An example is Solonetzic soils, which develop as a result of salinization. This may originate internally from a saline parent material, or from saturation by external saline waters. Solonetzic soils are found across many soil zones (figure 2). Azonal soils are soils without distinct genetic horizons and are represented by Regosolic soils in Canada. These occur across all the soil zones in the province.

The study area is situated in the Gray Luvisolic soil zone and the soils throughout most of the area are classified as Orthic Gray Luvisols, which are zonally normal. Exceptions are the Regosolic soils, which are azonal; and the Gleysolic and Organic soils, which are intrazonal. Regosolic and Gleysolic soils occur across all the soil zones,

and Organic soils occur in most. Soils of the study area can be considered typical locally (Lindsay *et al.*, 1968), but not quite so typical regionally, as Chernozemic soils become dominant a few kilometres to the east (Bowser *et al.*, 1962). However, Luvisolic soils are prevalent in all other directions.

Special features of soils in the study area are the inherent properties of Luvisolic and Organic soils. The Luvisolic soils in their natural state display surface leaf litter (L-H) and leached light gray colored Ae horizons, typical of soils developed under forest vegetation. The Ae horizons are underlain by much finer textured Bt horizons of clay accumulation. The Organic soils are soft and spongy to walk on, and hold vast quantities of water. These soil profiles do not display well-developed distinctive horizons that depict mineral soils. The soil materials resemble sponges and readily absorb water, which can easily be squeezed out in the hand. The humic materials, prevalent in the Humisols of Wabamun Lake Park, feel slippery and greasy when manipulated and squeezed in the hand.



Legend

1 - Brown soil zone

2 - Dark Brown soil zone

3 - Black soil zone

4 - Dark Gray and Dark Gray Luvisolic soil zone

5 - Mountain soils

6 - Gray Luvisolic soil zone

7 - Predominantly Brunisolic soils

- Predominantly Solonetzic soils (occur in association with all the above, except the Mountain and the Brunisolic soils).

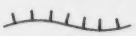
- Predominantly Organic soils (occur mainly in association with Gray Luvisolic soils).

Figure 2. Map showing soil zones of Alberta (from Alberta Institute of Pedology, undated)

Miscellaneous symbols

B This symbol indicates a beach, which is comprised of sand. The beach in Wabamun Lake Park appears to be man-made, whereby sand has been hauled in from another location, and spread over the original soil surface along the lakeshore.

DL This symbol indicates disturbed land, where the soil solum has been removed by construction activities, exposing the C horizon or soil parent material at the surface. The soil characteristics are generally similar to soil properties of C horizons of adjacent soils. These areas are generally level, except for the power line right-of-way adjacent to the northern park boundary. Topography here is similar to that of adjacent areas. These areas have slight limitations on suitable topography for buildings without basements; severe limitations for road location; very severe limitations for septic tank absorption fields and trench-type sanitary landfills; moderate limitations on suitable topography for all other uses; are poor sources of roadfill; and unsuitable as sources of sand or gravel due to unsuitable textures. Other limitations include high clay content, slippery or sticky when wet, slow permeability, lack of an Ah horizon, high lime content (soil nutrient imbalance), moderate to high shrink-swell potential, susceptibility to frost heave.



This symbol indicates escarpments. These have very severe limitations for all uses because of extreme slopes and erosion hazard.

P This symbol indicates parking areas.

Soil interpretations

An explanation of soil interpretations and definitions of the soil limitation and suitability ratings are given in Greenlee (1981). The results of soil chemical and physical analyses are given in tables 2 and 3.

Map Unit 1 soils cover most of the study area and are well suited for recreational development when found on suitable topography. They have moderate limitations for lawns and landscaping due to the lack of Ah horizons. Soils of the other map units have moderate to severe limitations due to various factors including seasonally high groundwater tables or surface ponding, flooding hazard (overflow), high clay content, slow permeability, slippery or sticky when wet, organic surface layer more than 15 cm thick, lack of Ah horizon, high lime content (soil nutrient imbalance), and Organic soil (Humisol map unit).

Map Unit 1 soils have severe limitations for road construction because of high shrink-swell potentials, susceptibility to frost heave, and excessive slopes. Soils of the other map units have severe to very severe limitations for most of the same reasons as well as seasonally high groundwater tables or surface ponding, flooding hazard (overflow), and Organic soil (Humisol map unit).

A source of sand or gravel was not found in the study area.

Specific limitations and suitabilities of the various soils for selected uses are shown in tables 4 to 15. The ratings were determined on the basis of morphological, physical and chemical properties of the soils, as well as steepness of slope. The principal limiting properties are indicated, and are generally listed in decreasing order of importance. In tables 4 to 13, the soil limitations for various uses have been designated as none to slight, moderate, severe and very severe. In tables 14 and 15, the suitability of soils as sources of roadfill and as sources of sand and gravel respectively, have been designated as good, fair, poor and very poor.

Table 2. Chemical analyses of selected map units[1]

Map Unit	Depth cm	pH H_2O	[2]EC	[3]Na	[3]SO_4	[3]OM	[3]$CaCO_3$
1	0-15	6.5	0.4	L	-	M-	-
	15-30	6.3	0.2	L-	-	M-	-
2	0-15	5.1	0.2	L	-	M-	-
	15-30	5.2	0.1	L	-	M-	-
3	0-15	7.8	3.3	L+	L+	M-	M-
	15-30	8.0	4.3	L+	M	M-	L

[1]Chemical analyses done by Alberta Soil and Feed Testing Laboratory.
[2]EC - electrical conductivity, millimhos/cm.

[3]These tests are rated into four categories: High (H), Medium (M), Low (L), and none (-). The degree within each category is indicated by a + or - sign. The tests for OM (organic matter) and $CaCO_3$ (free lime) are visual estimates only.

Table 3. Physical analyses of selected map unit[1]

Map unit	1
Depth cm	60-120
Field moisture %	16
Mechanical analysis	
Percentage passing sieve	
1 inch	100
3/4 inch	100
5/8 inch	100
#4 (4.7 mm)	100
#10 (2.0 mm)	100
#40 (0.42 mm)	94
#200 (0.074 mm)	65
Percentage smaller than	
0.05 mm	60
0.005 mm	40
0.002 mm	35
0.001 mm	29
Liquid limit	40
Plasticity index	19
Optimum moisture %[2]	21
Maximum dry density (lb/ft^3)[2]	100.0
Classification	
AASHO	A-6 (10) to A-7-6 (10)
Unified	CL
USDA	CL

[1]Map units developed on similar parent material: 1 and 3.

[2]These values are obtained from charts worked out by the Highways Testing Laboratory, Alberta Transportation.

Table 4. Soil limitations for fully serviced campgrounds

Map symbol[1]	Degree of limitation[2]
1/d1	SL
1/e1	M - Slope, Er
1/f1	S - Slope, Er
2/ao	S - Wet, Flood
3/Bo	M - Clay, SI Perm, Slip
4/ao	S - Wet, Org Surf, Flood
H/ao	VS - Org, Wet, Flood

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Clay - High clay content
Er - Erosion hazard
Flood - Flooding hazard (overflow)
Org - Organic soil
Org Surf - Organic surface layer >15 cm thick
Slip - Slippery or sticky when wet
Slope - Excessive slope
SI Perm - Slow permeability
Wet - Seasonally high groundwater table or surface ponding

Table 5. Soil limitations for picnic areas

Map symbol[1]	Degree of limitation[2]
1/d1	SL
1/e1	M - Slope, Er
1/f1	S - Slope, Er
2/ao	S - Wet
3/Bo	M - Clay, SI Perm, Slip
4/ao	S - Wet, Org Surf
H/ao	VS - Org, Wet

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Clay - High clay content
Er - Erosion hazard
Org - Organic soil
Org Surf - Organic surface layer >15 cm thick
Slip - Slippery or sticky when wet
Slope - Excessive slope
SI Perm - Slow permeability
Wet - Seasonally high groundwater table or surface ponding

Table 6. Soil limitations for lawns and landscaping

Map symbol[1]	Degree of limitation[2]
1/d1	M - Thin Ah
1/e1	M - Slope, Er, Thin Ah
1/f1	S - Slope, Er, Thin Ah
2/ao	S - Wet
3/Bo	M - Thin Ah, Lime, Clay
4/ao	S - Wet, Org Surf
H/ao	VS - Wet, Org, Thin Ah

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Clay - High clay content
Er - Erosion hazard
Lime - High lime conent (soil nutrient imbalance)
Org - Organic soil
Org Surf - Organic surface layer >15 cm thick
Slope - Excessive slope
Thin Ah - Thin or no Ah horizon
Wet - Seasonally high groundwater table or surface ponding

Table 7. Soil limitations for paths

Map symbol[1]	Degree of limitation[2]
1/d1	SL
1/e1	M - Slope, Er
1/f1	S - Slope, Er
2/ao	S - Wet
3/Bo	M - Clay, Slip
4/ao	S - Wet, Org Surf
H/ao	VS - Org, Wet

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Clay - High clay content
Er - Erosion hazard
Org - Organic soil
Org Surf - Organic surface layer >15 cm thick
Slip - Slippery or sticky when wet
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

Table 8. Soil limitations for trails

Map symbol[1]	Degree of limitation[2]
1/d1 1/e1	SL
1/f1	M - Slope, Er
2/ao	S - Wet
3/Bo	M - Clay, Slip
4/ao	S - Wet, Org Surf
H/ao	VS - Org, Wet

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Clay - High clay content
Er - Erosion hazard
Org - Organic soil
Org Surf - Organic surface layer > 15 cm thick
Slip - Slippery or sticky when wet
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

Table 9. Soil limitations for buildings with basements

Map symbol[1]	Degree of limitation[2]
1/d1	M - M Sh-Sw, Frost
1/e1	M - Slope, M Sh-Sw, Frost
1/f1	S - Slope, M Sh-Sw, Frost
2/ao	S - Wet, Flood, Frost
3/Bo	S - Wet, M Sh-Sw, Frost
4/ao	S - Wet, Flood, M Sh-Sw
H/ao	VS - Org, Wet, Flood

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Flood - Flooding hazard (overflow)
Frost - Susceptibility to frost heave
M Sh-Sw - Moderate shrink-swell potential
Org - Organic soil
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

Table 10. Soil limitations for buildings without basements

Map symbol[1]	Degree of limitation[2]
1/d1	SL
1/e1	M - Slope
1/f1	S - Slope
2/ao	S - Wet, Flood
3/Bo	SL
4/ao	S - Wet, Flood
H/ao	VS - Org, Wet, Flood

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Flood - Flooding hazard (overflow)
Org - Organic soil
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding.

Table 11. Soil limitations for septic tank absorption fields

Map symbol[1]	Degree of limitation[2]
1/d1	S - Sl Perm
1/e1	S - Sl Perm, Slope
1/f1	S - Slope, Sl Perm
2/ao	VS - Wet, GW, Flood
3/Bo	VS - Wet, GW, Sl Perm
4/ao	VS - Wet, GW, Flood
H/ao	VS - Org, Wet, GW

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Flood - Flooding hazard (overflow)
GW - Groundwater contamination hazard
Org - Organic soil
Slope - Excessive slope
Sl Perm - Slow permeability
Wet - Seasonally high groundwater table or surface ponding

Table 12. Soil limitations for trench-type sanitary landfills

Map symbol[1]	Degree of limitation[2]
1/d1 1/e1	M - Clay
1/f1	M - Slope, Clay
2/ao	VS - Wet, GW, Flood
3/Bo	VS - Wet, GW, Clay
4/ao	VS - Wet, GW, Flood
H/ao	VS - Org, Wet, GW

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Clay - High clay content
Flood - Flooding hazard (overflow)
GW - Groundwater contamination hazard
Org - Organic soil
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

Table 13. Soil limitations for road location

Map symbol[1]	Degree of limitation[2]
1/d1	S - Sh-Sw, Frost
1/e1	S - Sh-Sw, Slope, Frost
1/f1	S - Slope, Sh-Sw, Frost
2/ao	S - Wet, Flood, Frost
3/Bo	S - Sh-Sw, Frost
4/ao	S - Wet, Sh-Sw, Frost
H/ao	VS - Org, Wet, Sh-Sw

[1] - For explanation, see Soil Map.
[2] - SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

Abbreviations

Flood - Flooding hazard (overflow)
Frost - Susceptibility to frost heave
Org - Organic soil
Sh-Sw - High shrink-swell potential
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

Table 14. Soil suitability for source of roadfill

Map symbol[1]	Degree of limitation[2]
1/d1 1/e1	P - Sh-Sw, Frost
1/f1	P - Sh-Sw, Slope, Frost
2/ao	P - Wet, Frost
3/Bo	P - Sh-Sw, Frost, Wet
4/ao	P - Wet, Sh-Sw, Frost
H/ao	VS - Org, Wet, Sh-Sw

[1] - For explanation, see Soil Map.
[2] - G - Good, F - Fair, P - Poor, VP - Very Poor.

Abbreviations

Frost - Susceptibility to frost heave
Org - Organic soil
Sh-Sw - High shrink-swell potential
Slope - Excessive slope
Wet - Seasonally high groundwater table or surface ponding

Table 15. Soil suitability for source of sand or gravel

Map symbol[1]	Degree of limitation[2]
1/d1 1/e1 1/f1	VP - Text
2/ao	VP - Text, Wet
3/Bo	VP - Text, Wet
4/ao	VP - Text, Wet
H/ao	VS - Org, Text, Wet

[1] - For explanation, see Soil Map.
[2] - G - Good, F - Fair, P - Poor VP - Very poor.

Abbreviations

Org - Organic soil
Text - Unsuitable texture
Wet - Seasonally high groundwater table or surface ponding

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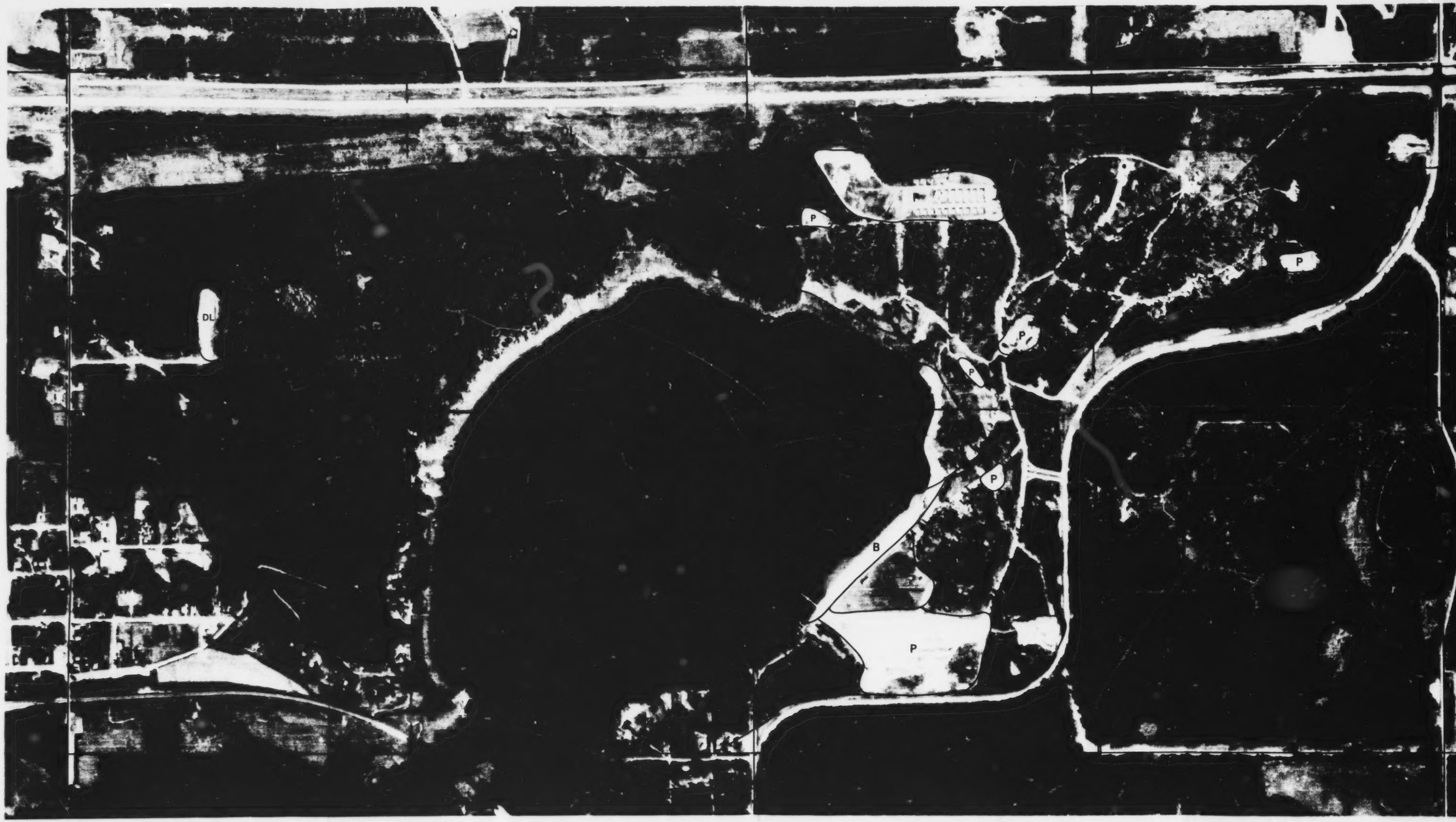
LANDFORM MAP OF WABAMUN LAKE PROVINCIAL PARK STUDY AREA

Tp 53 R 3-4 W



APPROXIMATE SCALE 1:8000

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STUDY AREA

Tp 53 R 3-4 W5M

APPROXIMATE SCALE 1:8000

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LEGEND:

A - Anthropogenic

Av/Ll - anthropogenic veneer, overlying level lacustrine

L - Lacustrine

Ll - level lacustrine

M - Morainal

Mh - hummocky morainal

N - Fen

Nh - horizontal fen

- landform line
- boundary of mapped area
- escarpment

B - beach

D.L. - disturbed land

P - parking area

- direction of slope

APPROXIMATE SCALE 1:8000

666 0 666 1332 1998 Feet

160 0 160 320 480 Metres

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Soils Department
1983

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666 0 666 1332 1998 Feet

160 0 160 320 480 Metres

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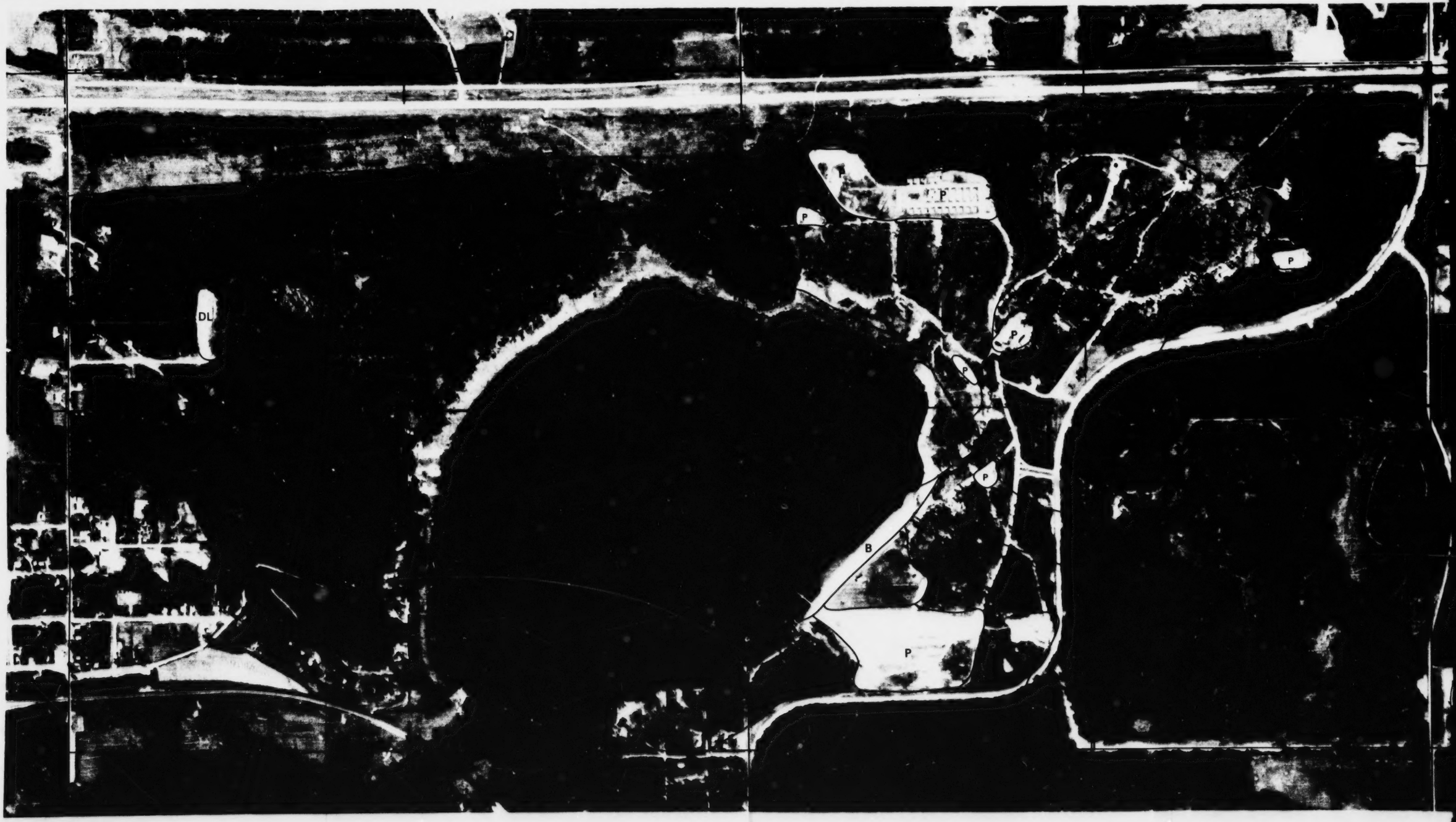
SOIL MAP OF WABAMUN LAKE PROVINCIAL PARK STUDY AREA

Tp 53 R 3-4



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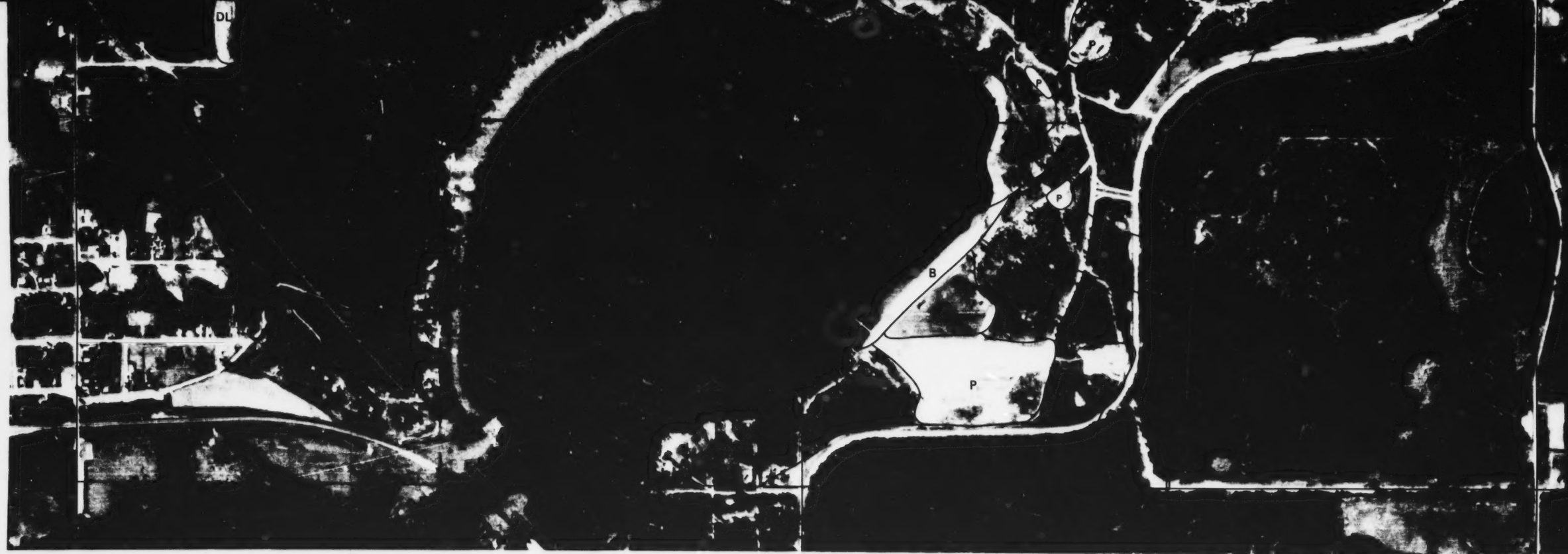

SOIL CLASSIFICATION

MAP UNIT	SOIL ORDER	SOIL SUBGROUP	SOIL PARENT MATERIAL
1	Luvisolic	Orthic Gray Luvisol	moderately fine textured till
2	Gleysolic	Orthic Humic Gleysol	medium to moderately fine textured lacustrine
3	Regosolic and Gleysolic	Orthic Regosol overlying Rego Gleysol, peaty phase	moderately fine textured till, overlying moderately fine textured lacustrine
4	Gleysolic	Humic Luvic Gleysol, peaty phase	moderately fine textured lacustrine
H	Organic	Humisol (undifferentiated)	humic peat

LEGEND:

Map Symbol:

2 — map unit
b0 — surface stoniness rating
topographic class

- soil line
- boundary of mapped area
- escarpment

B - beach

D.L. - disturbed land

P - parking area

- direction of slope

APPROXIMATE SCALE 1:8000

666 0 666 1332 1998 Feet

160 0 160 320 480 Metres

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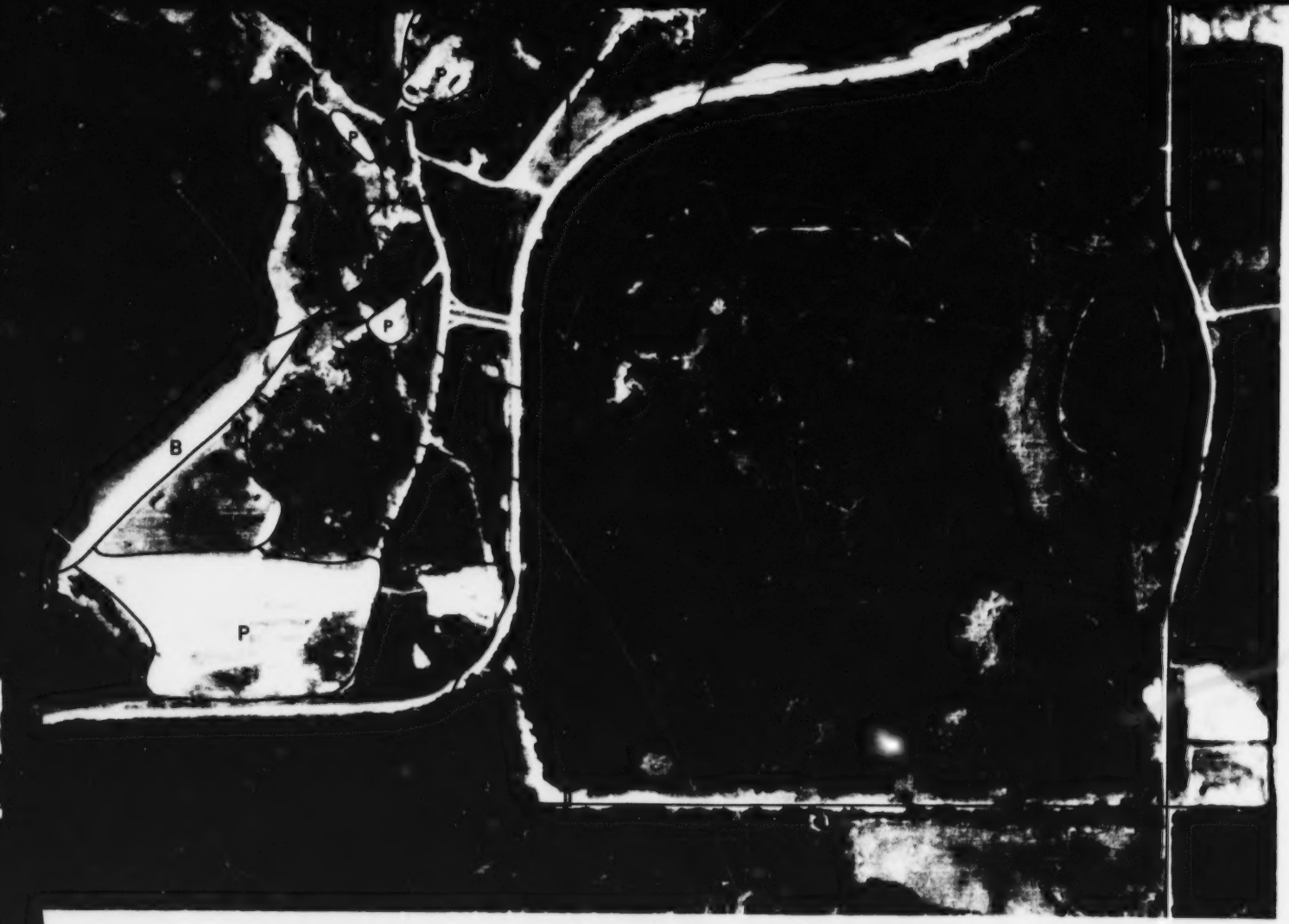

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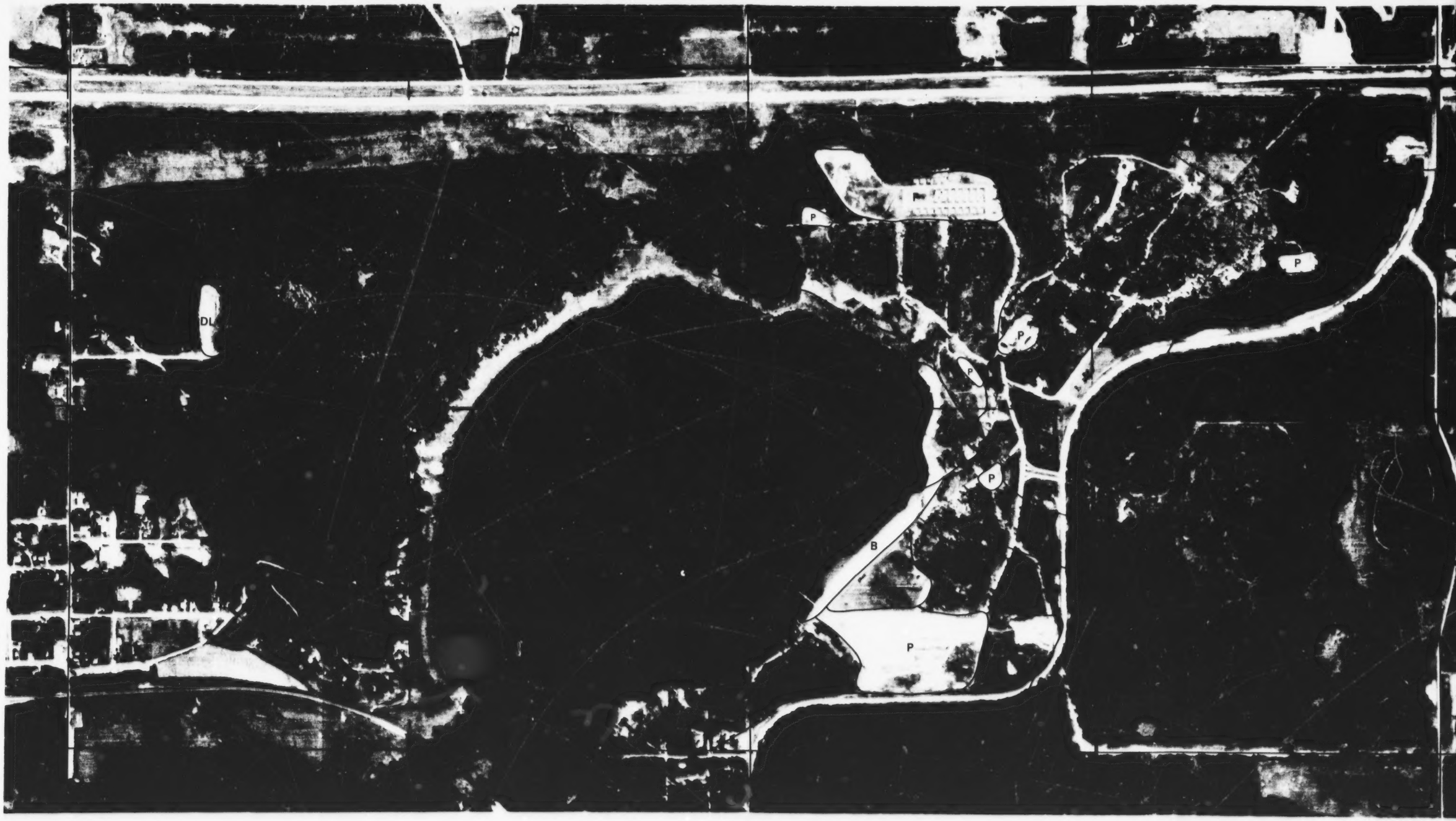
SOIL LIMITATIONS FOR RECREATION IN WABAMUN LAKE PROVINCIAL PARK STUDY AREA

Tp 53 R 3-4



APPROXIMATE SCALE 1:8000

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PROVINCIAL PARK STUDY AREA

Tp 53 R 3-4 W5M

APPROXIMATE SCALE 1:8000

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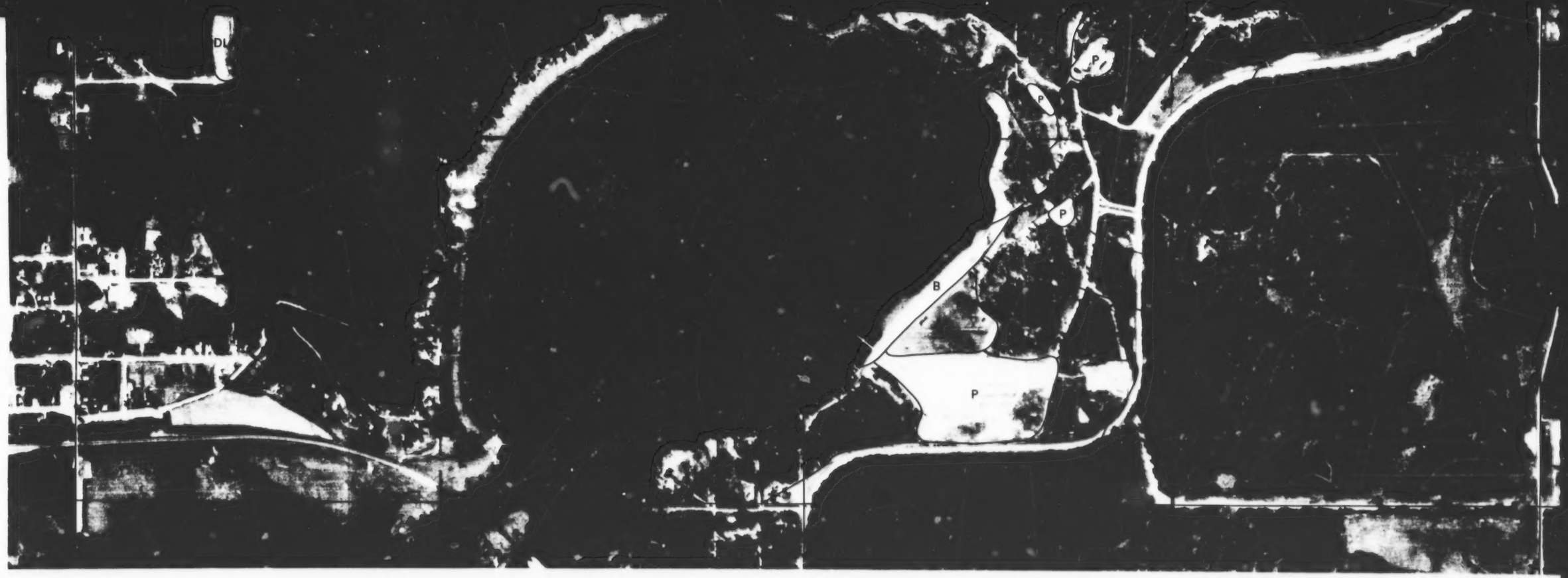

LEGEND:

SL	-none to slight soil limitations
M	-moderate soil limitations
S	-severe soil limitations
VS	-very severe soil limitations

- soil limitation line
- boundary of mapped area
- escarpment
- B - beach
- D.L. - disturbed land
- P - parking area
- direction of slope

APPROXIMATE SCALE 1:8000

666 0 666 1332 1998 Feet

160 0 160 320 480 Metres

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APPROXIMATE SCALE 1:8000

666 0 666 1332 1998 Feet

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